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Survival Outcomes and Causes of Death of Trauma Patients: Examining the Concordance of External Causes of Morbidity and Mortality Data.

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Abstract

Deaths during, and after, hospitalisation of trauma patients are frequently used as outcome measures to examine the effectiveness of trauma treatment systems. However, there has been little research examining the concordance of morbidity and mortality data across the outcome continuum from admission to death. This research examined the concordance of morbidity and mortality external cause data for trauma patients up to one year post-discharge.

This study used data-linkage methodologies to match and compare documentation from three sources: a trauma registry, a metropolitan hospital, and the National Death Index. Survival outcomes were examined at hospital discharge, one, two and twelve months post-discharge. To examine the concordance of morbidity and mortality data, the World Health Organization special tabulation list for external causes was used to categorise external causes and classify cases as matching, not matching, or no trauma recorded.

Of the 1672 injury-related hospital presentations, 140 (8.4%) died within one year post-injury, with 60 deaths during hospital admission, 17 deaths within 30 days post-discharge, 8 deaths within 31-60 days post-discharge, and 55 deaths between 61 days and 1 year post-discharge. The external causes of injuries associated with the highest mortality rates were Accidental Falls (16% died: 22% of the deaths occurred during hospital admission, 24% within 60 days post-discharge) and Intentional Self-Harm (11.5% died: 70% of the deaths occurred during hospital admission). Approximately 90% of deaths within 30 days post-discharge and all deaths between 31-60 days post-discharge had either no match between the external cause of morbidity and mortality or had no trauma coded from the documentation available on the death certificate.

This study identified a significant lack of concordance of cause of injury data between hospital databases and the national death index for deaths occurring within 60 days post-discharge. This study has implications for researchers and policymakers involved in examining trauma outcomes.

Introduction

The mortality rate during hospitalisation of patients admitted for acute trauma is frequently used as an outcome measure in research related to the effectiveness of trauma systems. While mortality rates during hospitalisation for trauma are an important quality of care indicator, any evaluation of trauma related deaths would be biased if analyses were limited to patients who died whilst hospitalised (1). Several authors have highlighted the need to examine the outcomes of trauma patients post-discharge to provide a more complete picture of quality of care (1, 2).

However, deaths of trauma patients (particularly post-discharge mortality) may be due to the injuries that caused the hospitalisation or to other unrelated causes. Evaluations of trauma outcomes need to examine the causes of death and the relationship of these causes to the causes of hospitalised trauma. Olson et al examined the death rate of trauma patients at discharge and again at one-year post-discharge and found that for patients under 65 years of age, 50% had an injury recorded on their death certificate, compared to just 29% of patients over 65 years of age, though this research did not examine whether the injuries recorded on the death certificate were the same injuries resulting in hospitalisation (2). Older people are more likely to have other co-morbidities that complicate their trauma admission than younger people, which arguably increases their vulnerability post-injury (1-4). While it is possible older people may die as a result of these other co-morbidities, it could be argued that the injury places these patients at a higher risk of dying from other causes than would occur in the absence of the injury. As such, it is important to consider both trauma deaths and deaths from other medical conditions when conducting trauma outcome research (5, 6).

Morbidity and mortality data are vital sources of information when conducting trauma outcome research. Nationally and internationally, morbidity and mortality data are coded according to the International Classification of Diseases and Related Health Problems (ICD) system. The International Classification of Diseases and Related Health Problems (ICD-10) is the international standard health classification published by World Health Organization (WHO) for coding diseases and other health issues for national and international statistical aggregation and reporting purposes (7). The External Causes of Morbidity and Mortality chapter (Chapter XX) describes the causes of injury, poisoning and adverse events. In morbidity coding, external cause codes are assigned as additional codes supplementary to codes from other chapters of the Australian modification of ICD-10 which describe nature of injury and disease. In mortality coding, the external cause for cases of deaths due to accidents or trauma is assigned as the underlying cause of death (UCOD). All other conditions, including the injuries resulting from the external cause, are coded as multiple causes of death (MCOD). The use of MCOD data (that is, considering all causes reported on the death certificate, not only the UCOD), especially in relation to injuries and older patients, has been promoted by several other authors, as a means to establish a better understanding of the true impact of trauma on mortality outcomes (1, 2).

Trauma outcome researchers need to be aware however, that the quality of coded morbidity and mortality data are affected by several factors including the quality of documentation in the source record and the accuracy of the coding process (8). If clinicians fail to provide adequate documentation about each individual, coders are

limited in range of codes they can accurately assign to describe the individual's circumstances. Poor documentation within the source record from which the coding is being performed has been shown to decrease data quality by contributing to an overuse of non-specific 'dump' codes (9, 10). Clinical coders may make errors in their coding by not adhering to the ICD rules and guidelines. Previous research using ICD-9-CM in Victoria has identified errors in external cause coding in 16% of medical records, with errors in the external cause codes allocated, errors of omission, and use of unnecessary external cause codes the main types of errors (11). When comparing coded data, researchers have found that using broader categories of ICD codes (such as three-digit codes) improves data reliability (12).

Objectives

This research examined the survival outcomes and concordance of morbidity and mortality external cause data for hospitalised trauma patients up to one year post-discharge. The specific research questions were:

1. What were the survival outcomes of trauma patients?
2. Was trauma recorded on the death certificate of patients who died post-discharge?
3. If trauma was recorded, was there concordance in the coded data between the morbidity and mortality collections for trauma patients who died post-discharge?

Method

Participants and Procedure

This study used data-linkage and health classification methodologies to match and compare documentation from three sources: a trauma registry, a major metropolitan teaching hospital, and the National Death Index (NDI). Participants included 1672 patients registered in the trauma registry in 1998 who were admitted to hospital for 24 hours or more following an injury. Approval from University, Hospital, and Australian Institute of Health and Welfare human research ethics committees were obtained prior to undertaking this research.

Data Linkage Methodology

Trauma registry records were matched to hospital records to obtain admission and discharge details and coded diagnoses of all cases in the sample (For more detail of the concordance of hospital records and trauma registry records see McKenzie et al (2005) (13)). Demographic variables including name, sex, date of birth and available dates of death were selected from the trauma registry's 1998 data, and provided to the Australian Institute of Health and Welfare (AIHW) for matching purposes. The Australian NDI provides mortality information for all deaths occurring in Australia since 1980 for the purposes of epidemiological research (14). The NDI includes UCOD for all data years and MCOD information for deaths occurring since 1997. Data are matched using probabilistic matching and research examining the accuracy of NDI matches has reported specificity of 98.5% and sensitivity of 89.2% (15).

Classification of Causes of Injury

When examining and comparing ICD codes, broad categories of codes were used to ensure any differences detected highlighted significant data variations that have epidemiological importance, rather than specific coding discrepancies which have minimal impact on trauma epidemiological patterns. The WHO produces special tabulation lists of ICD-10 codes for the aggregation, comparison and reporting of causes of death and morbidity. These tabulation lists group codes into larger categories, with the external causes of injuries classified into 13 categories. The categories include broad accidental causes of injury of such as motor vehicle, poisoning, falls, fire and flames, drowning and submersion, machinery and firearms as well as drug adverse events, suicide and self-inflicted injuries and homicide and deliberate injuries.

To examine the concordance of morbidity and mortality data, external causes of injury recorded in hospital records and external causes of injury resulting in death (both UCOD and MCOD) were grouped according to this WHO external cause list and cases were classified as either matching or not matching within these broad categories. An expert clinical coder then compared the full external cause codes in hospital records and the NDI for the unmatched cases to identify the source of the inconsistency, being 1) more defined external cause code in the NDI than the hospital records, 2) less defined external cause code in the NDI than the hospital records, or 3) different external cause code in the NDI than the hospital records. By less defined codes, we refer to the use of 'dump' codes or non-specific ICD codes, which provide limited information about the specific cause of the injury, such as the code X59 'Exposure to Unspecified Factor'.

NDI matched cases were also categorised as 1) dying from a medical condition with no trauma recorded on the death certificate, 2) dying from a medical condition with trauma recorded as a MCOD or 3) dying from trauma with an external cause as the UCOD.

Statistical Analyses

Survival outcomes were examined at hospital discharge and one, two and twelve months post-discharge. As this research compared multiple sources of data at various time-points using a relatively small sample size, statistical analysis was limited to descriptive analyses for this paper. The research is currently being extended to include a significantly larger sample to enable more detailed statistical analyses.

Results

Survival Outcomes by Cause of Hospitalised Injury and Age Group

Of the 1672 injury presentations, 60 (3.6%) cases died during the hospital admission, 17 (1.0%) died within 30 days post-discharge, 8 (0.5%) died between 31 and 60 days post-discharge, 55 (3.3%) died between 61 days and 1 year post-discharge, and 1532 (91.6%) cases were alive at the one-year census date. This resulted in an overall one-year mortality rate of 8.4%. The causes of hospitalised injuries associated with the highest mortality rates were Accidental Falls and Self Inflicted Injuries (See Table 1).

Survival outcomes differed between those who were less than 65 years of age and those who were 65 years of age or more (See Table 2). Notably, all of the patients over 65 years of age who died within 60 days post-discharge had been admitted to hospital with an injury caused by an accidental fall.

Table 1: Cause of Hospitalised Injury by Patient Survival Outcomes

Cause of Hospitalised Injury	Alive		Hospital death		Post-Discharge Deaths					
					<30days		31-60 days		61 days-1yr	
	n	%	n	%	n	%	n	%	n	%
Motor vehicle traffic accidents	328	94.8	16	4.6	1	0.3	0	0	1	0.3
Other transport accidents	62	98.4	1	1.6	0	0	0	0	0	0
Accidental poisoning	59	96.7	2	3.3	0	0	0	0	0	0
Accidental falls	509	84.3	21	3.5	15	2.5	8	1.3	51	8.4
Accidents caused by fire and flames	74	91.4	7	8.6	0	0	0	0	0	0
Accidental drowning and submersion	2	100	0	0	0	0	0	0	0	0
Accidents caused by machinery	164	98.8	1	0.6	0	0	0	0	1	0.6
All other accidents, incl. late effects	150	99.3	1	0.7	0	0	0	0	0	0
Suicide and self- inflicted injury	77	88.5	7	8.0	1	1.1	0	0	2	2.3
Homicide	106	97.2	3	2.8	0	0	0	0	0	0
Other external causes	1	50.0	1	50.0	0	0	0	0	0	0
TOTAL	1532	91.6	60	3.6	17	1.0	8	0.5	55	3.3

Table 2 Patient Survival Outcomes by Age

Survival Outcomes	Age < 65		Age $\geq$ 65	
	n	%	n	%
Hospital death	30	2.5	30	6.4
Deaths within 30 days post-discharge	3	0.2	14	3.0
Deaths 31-60 days post-discharge	0	0	8	1.7
Deaths 61 days-1 year post-discharge	5	0.4	50	10.7
Alive	1168	96.8	364	78.1
TOTAL	1206	100	466	100

Cause of Hospitalised Injury by Cause of Death Post-Discharge

Deceased patients were classified as dying from a medical condition with no trauma coded, dying from a medical condition with trauma as a MCOD, or dying from trauma. Over 10% of patients who were hospitalised due to injuries and subsequently died in hospital had no trauma coded in the NDI (See Allison et al, 2006). For deaths up to 60 days post-discharge, all but 2 of the patients were over 65 years of age. Almost 70% of patients who were hospitalised due to injuries caused by an accidental fall and died within 60 days post-discharge from hospital had no trauma coded in the NDI (See table 3).

Table 3: Cause of Hospitalised Injury by UCOD for Post-Discharge Deaths (up to 60 days)

Cause of Hospitalised Injury	Medical UCOD No Trauma		Medical UCOD Trauma MCOD		Trauma as UCOD	
	n	%	n	%	n	%
Accidental falls	16	69.6	2	8.7	5	21.7
Suicide and self- inflicted injury	0	0	0	0	1	100
TOTAL	16	66.7	2	8.3	6	25.0

Missing n=1 (COD unknown)

Cause of Hospitalised Injury Concordance with Cause of Injury in NDI

Causes of injuries did not match for three-quarters of patients who were hospitalised due to injuries and died within 60 days post-discharge, and only one accidental falls case had a matching cause of injury recoded in the NDI (See Table 4). Similar to the hospital deaths (as reported by Allison et al, 2006), all of the Accidental falls cases where data was inconsistent between hospital records and the NDI, were assigned to the 'dump' external cause code 'Exposure to an Unspecified Factor'(see table 4).

Table 4: Cause of Hospitalised Injury Concordance with Cause of Injury in NDI for Post-Discharge Deaths (up to 60 days)

Cause of Hospitalised Injury	Cause of Injury Matched		Cause of Injury Not Matched	
	n	%	n	%
Accidental falls	1	14.3	6	85.7
Suicide and self- inflicted injury	1	100	0	0
TOTAL	2	25.0	6	75.0

Missing n=1 (COD unknown) ; Note – Does not include 16 cases with no trauma recorded in NDI.

Discussion

The in-hospital and post-discharge mortality rates for trauma patients reported in this research was consistent with the mortality rates of similar cohorts of trauma patients reported in the literature (1, 2).

Over 10% of patients who died in hospital and over 2/3 of patients who died within 60 days of discharge from hospital had no trauma coded as an underlying or associated cause of death, particularly when the patient was over the age of 65 years. Furthermore, where trauma was recorded in the death certificate, three-quarters of deaths within 60 days post-discharge had different causes of injury reflected in the morbidity data compared to mortality data, usually as a result of poorly defined external causes in mortality data. This finding was consistent with previous research conducted by Johansson and Westerling (2002) who found that by including additional information from hospital discharge databases, around 11% of death certificates were improved from poorly defined causes of death to more specific causes of death (16). While only conducted on a small sample of cases, these findings reveal a significant gap for trauma outcome researchers. Using hospital morbidity data or mortality data alone would not sufficiently capture or describe all cases who die following hospitalisation for trauma.

As stated previously, it could be argued that the injury, especially in the elderly, places individuals at a higher risk of dying from other causes. As such, for cases where a significant trauma such as that caused by an accidental fall has resulted in hospitalisation and occurred close in proximity to the person's death, trauma outcome research could be significantly enhanced if both the injury and corresponding external cause of death were reflected on the death certificate as either an underlying or multiple cause depending on the individual case (5, 6). This would provide trauma outcome researchers with a more comprehensive mortality data source to enable a better understanding of the true impact of trauma on mortality outcomes (1, 2).

Conclusion

This research has identified some of the complexities and issues that need to be considered when examining fatal trauma outcomes. The researchers agree that non-fatal outcomes such as quality of life and physical functioning post-traumatic event are equally important outcomes to measure (17). Furthermore, it is essential that trauma outcome researchers appreciate that mortality rates alone are crude trauma outcome measure, with issues such as post-discharge mortality, mortality data quality, concordance of data across sources, and underlying vs multiple causes of death being relevant data considerations that need to be adequately addressed.

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